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OVERSIGHT

Integrated Safety Management Evaluation of

Lawrence Livermore National Laboratory

November 1997

Office of Environment, Safety and Health

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Abbreviations Used in This Report

DOE	U.S. Department of Energy
DP	DOE Office of Defense Programs
EH	DOE Office of Environment, Safety, and Health
EM	DOE Office of Environmental Management
ER	DOE Office of Energy Research
ES&H	Environment, Safety, and Health
ESHD	Environment, Safety, and Health Division
FRAM	Functions, Responsibilities, and Authorities Manual
FY	Fiscal Year
ISM	Integrated Safety Management
LLNL	Lawrence Livermore National Laboratory
LSO	Livermore Site Office
NE	DOE Office of Nuclear Energy, Science, and Technology
NN	DOE Office of Nonproliferation and National Security
OAK	DOE Oakland Operations Office
UC	University of California

OVERSIGHT

Executive Summary

EVALUATION:	Office of Oversight Evaluation of Integrated Safety Management
SITE:	Lawrence Livermore National Laboratory, Livermore, California
DATES:	September - November 1997

Scope

The U.S. Department of Energy (DOE) Office of Oversight evaluated the safety management program at Lawrence Livermore National Laboratory (LLNL), as implemented by the responsible management elements at DOE Headquarters—the Offices of Defense Programs (DP) and Environmental Management (EM); the DOE Oakland Operations Office (OAK); the prime contractor—the University of California (UC); and selected subcontractors. The evaluation focused on selected LLNL facilities and environment, safety, and health (ES&H) programs, such as radiological protection and industrial hygiene.

Results

OAK, UC, and LLNL have clearly defined safety management policies and performance expectations at the top levels of the organization. They are committed to the implementation of Integrated Safety Management (ISM) and Work Smart standards, including the recent incorporation of ISM into the UC contract. Through a "Partnership for Performance," OAK, UC, and LLNL are teaming to actively seek and analyze performance information and continuously improve ES&H performance at the Laboratory. This is being accomplished through contract performance measures, analysis and trending, and increasing independent and self-assessment activities. OAK, UC, and LLNL have established and implemented many of the essential elements of safety management, including clear roles and responsibilities, mechanisms for contractual and individual accountability, appropriate balance between ES&H and mission-related priorities, and the effective identification of requirements. These elements of safety management are reflected in the safe conduct of many mission-related activities and work, including the effective safety and hazard controls at the Site 300 Explosives Test Area. Despite these successes, however, OAK and LLNL senior management have recently acknowledged, based on continuing events and performance problems in some areas of safety, a need to improve LLNL safety performance. Successfully implementing integrated safety management and achieving the improvements in safety performance desired by LLNL senior management will require strengthening the management systems and the organizational culture to ensure understanding, acceptance, and sustained implementation at every level of the organization.

DOE and LLNL processes for establishing and balancing priorities between mission-related and ES&H activities and resource needs have been demonstrated to be effective and appropriately involve LLNL stakeholders. DP, EM, and OAK are supportive of LLNL ES&H infrastructure requirements, including maintenance and upgrades of safety systems, fire protection, and environmental monitoring, protection, and remediation. LLNL has established and implemented a model program for the effective upkeep, deactivation, reuse, and disposition of excess facilities or equipment. Management's recognition of the priority of ES&H was recently demonstrated through the LLNL voluntary stand-down of plutonium facility operations because of criticality safety concerns. This extended

stand-down was implemented despite a significant impact on an important ongoing mission campaign.

OAK, UC, and LLNL have increased their efforts to monitor LLNL ES&H performance, including establishing a performance-based contract and associated performance criteria. OAK has significantly increased its presence at the LLNL site to oversee and support LLNL operations and ES&H. The OAK Facility Representative Program is increasingly effective, demonstrates good teamwork, and is in the process of receiving additional ES&H resource support from OAK. UC is actively monitoring and trending ES&H performance measures. LLNL has established a wide range of independent assessments and self-assessment activities across the Laboratory organizations. The contribution of all of these performance feedback activities to improving LLNL safety performance and the implementation of ISM could be substantially strengthened through increased focus on human performance, improved documentation and tracking of issues, and more timely and effective corrective actions for issues and systemic weaknesses.

In most cases, hazards at major programs are well-analyzed and controlled at the Laboratory. OAK and LLNL are actively engaged in upgrading the safety analysis reports to meet new DOE requirements. Additional management attention is warranted to improve the quality, scope, and documentation of the hazards analysis that support LLNL emergency management to assure that the full spectrum of site activities, hazards, and potential accidents are addressed; to ensure that hazards analysis and work controls are effective for all work activities, including maintenance and subcontracted work; and to improve performance assessments and feedback mechanisms to ensure that root causes are addressed and corrective actions are effective.

Based on a number of recent events and a continued relatively high worker injury rate, the OAK Manager and the Laboratory Director have recently acknowledged and communicated a need for additional improvements in LLNL safety performance and a change to the safety culture. This recognition has contributed to a number of new OAK and LLNL improvement initiatives and a senior management commitment to ISM.

These senior management policies, commitments, and acknowledgments of a need for change, however, have not yet permeated the other levels of the LLNL organization to a degree that can accomplish a change in safety culture or effective implementation of ISM. Top level policies and ISM have not yet been effectively translated into implementing policies, specific requirements, procedures, or work planning and control processes. The levels of leadership essential to achieving a change in safety culture and implementation of ISM, including understanding, acceptance, and accountability, and sustained implementation is still not apparent within many levels of the LLNL organization. The inability to achieve the desired change and level of ES&H performance is reflected in injury/lost workday rates, significant and repetitive events, accidents, near misses, procedural non-compliances, and continuing hazards and work control deficiencies.

A significant barrier to successful implementation of ISM and to improvements in LLNL safety performance is the absence of a common work planning and control process that effectively encompasses all site activities. Although many elements of work control have evolved, they tend to be facility-specific and are not integrated or institutionalized. Some work activities are conducted informally and outside of these elements. LLNL events indicate continuing and systemic deficiencies in areas such as inadequate hazard analysis, hazard controls, work instructions, procedure use and compliance, involvement by safety professionals, pre-job briefings, and work supervision. A common process or mechanism is needed to ensure that the five core functions of ISM are applied to each and every site activity, as appropriate to the level of hazard.

Conclusions

From an overall safety management perspective, OAK, UC, and LLNL senior management have established and implemented a number of essential elements, including clear delineation of roles and responsibilities, a performance-based contract, an effective process for prioritizing and balancing mission activities, and ES&H mechanisms for contractual and individual accountability. LLNL has a mature matrixed organization that provides maximum flexibility in the utilization and sharing of technical and ES&H resources. Senior management from all three organizations has acknowledged the need for improvements in ES&H

performance and the LLNL safety culture and are committed to ISM to accomplish these goals. This recognition has produced a significant number of OAK and LLNL improvement initiatives, some of which are too recent to have produced results or to be evaluated at this time.

Top-level policies and commitments, however, have not yet been effectively translated into LLNL implementing policies, procedures, or work control processes. Recent events are indicative of safety management weaknesses that constitute a continuing and unnecessary challenge to both worker safety and health and the LLNL mission. The commitment and vision of top management, no matter how strong, cannot achieve organizational change and performance improvement alone. Other levels of the LLNL organization need to acknowledge the need for change, embrace ISM as a truly new approach to conducting all site activities, and be provided with the clear and specific expectations and mechanisms to achieve the necessary changes. If ISM is to be successful in improving LLNL ES&H performance, LLNL managers and supervisors must become the agents for change by increasing field presence, training, coaching, providing constructive feedback to workers, and providing the leadership essential to understanding, acceptance, and sustained implementation of ISM by LLNL employees and subcontractors.

The existing elements of LLNL safety management, coupled with the maturing of the numerous improvement initiatives, and strengthened leadership and acceptance of a need for change at every level of the organization, has the potential to achieve the desired improvements to safety performance, and to support the effective and timely implementation of Integrated Safety Management.

1.0 Introduction

The Office of Environment, Safety and Health conducted a safety management evaluation at LLNL.

The U.S. Department of Energy (DOE) Office of Environment, Safety and Health (EH) conducted an independent oversight evaluation of safety management at Lawrence Livermore National Laboratory (LLNL) from September to November 1997. The purpose of the evaluation was to determine how effectively DOE and contractor line management have implemented integrated safety management (ISM) and environment, safety, and health (ES&H) programs at LLNL.

Established in 1952, LLNL's primary mission is research, development, and maintenance of nuclear weapons designs. LLNL also performs basic and applied research in strategic defense, energy, environmental science, biomedicine, and education. In recent years, LLNL has increasingly emphasized partnerships with universities and industry and the commercialization of technology.

LLNL is a multi-program research laboratory that receives direction from many DOE program offices.

As one of several DOE multi-program laboratories, LLNL receives programmatic direction and funding from several DOE program offices, including the Offices of Defense Programs (DP), Energy Research (ER), Nuclear Energy, Science and Technology (NE), Environmental Management (EM), and Nonproliferation and National

TERMINOLOGY

Safety management refers to those systems required to ensure that an acceptable level of protection of the public, workers, and environment is maintained throughout the life of a facility or operation. The term "safety," when used in the context of safety management or the safety management program, specifically includes all aspects of ES&H.

Line management refers to the chain of command that extends from the Secretary of Energy through the Deputy Secretary or Under Secretary to the cognizant secretarial officers, DOE operations office managers, and contractors. Line management consists of DOE and contractor personnel organizationally or contractually responsible for work or job tasks (Figures 1 and 2).

Integrated safety management system (ISM) refers to a comprehensive and coordinated program of ES&H expectations and activities. The recently issued DOE Policy 450.4, *Safety Management System*, defines six components of an ISM program: the objective, guiding principles, core functions, mechanisms, responsibilities, and implementation. These components (Figure 3) provide the framework for the Office of Oversight's evaluation of the LLNL safety management program.

Security (NN). LLNL also performs work for other U.S. government agencies, other countries, and industry under a variety of cost-reimbursement arrangements. LLNL receives operational direction from DOE's Oakland Operations Office (OAK).

This safety management evaluation of LLNL focuses on the effectiveness of DOE Headquarters program offices (DP and EM), OAK, the University of California (UC), LLNL, and selected LLNL subcontractors in implementing the objectives, principles, and core functions of an ISM system.

Figure 1 shows a simplified view of the DOE and contractor organizations that have key roles in managing activities at LLNL. Figure 2 shows simplified versions of the OAK and LLNL organizational structures. Figure 3 shows the components of ISM as defined in DOE Policy 450.4, *Safety Management System*. As discussed in Appendix A, seven elements reviewed in this Safety Management Evaluation closely correspond to the seven guiding principles but have been adjusted to provide a more effective independent evaluation of the safety management program.

ORGANIZATIONS RESPONSIBLE FOR LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL)

HEADQUARTERS: The cognizant secretarial office is the Office of Defense Programs. The DOE Office of Environmental Management also has significant program management responsibilities and interests in the areas of environmental restoration and waste management. Other DOE program offices, such as the Offices of Energy Research, Nuclear Energy, Science and Technology, and Nonproliferation and National Security, provide programmatic direction and funding for LLNL programs.

OAKLAND OPERATIONS OFFICE (OAK): Located in Oakland, California, OAK manages activities at LLNL and a number of other sites (Lawrence Berkeley National Laboratory and the Stanford Linear Accelerator Center). OAK has approximately 360 personnel, 116 of whom are stationed at the LLNL site.

UNIVERSITY OF CALIFORNIA (UC)/LLNL: The prime contractor for LLNL is UC, which has operated LLNL since its inception in 1952. UC also operates Los Alamos National Laboratory and Lawrence Berkeley National Laboratory at DOE's direction. As a national laboratory, LLNL facilities and equipment are owned by the U.S. government and operated by contractor employees under a contract between DOE and UC.

SUBCONTRACTORS: LLNL uses a number of subcontractors, including those involved in activities such as construction and facility maintenance. NOTE: When used to refer to an organization, "LLNL" refers to the contractor employees that are directly involved in operating LLNL. "LLNL" is also used to refer to the facilities and property that constitute the laboratory.

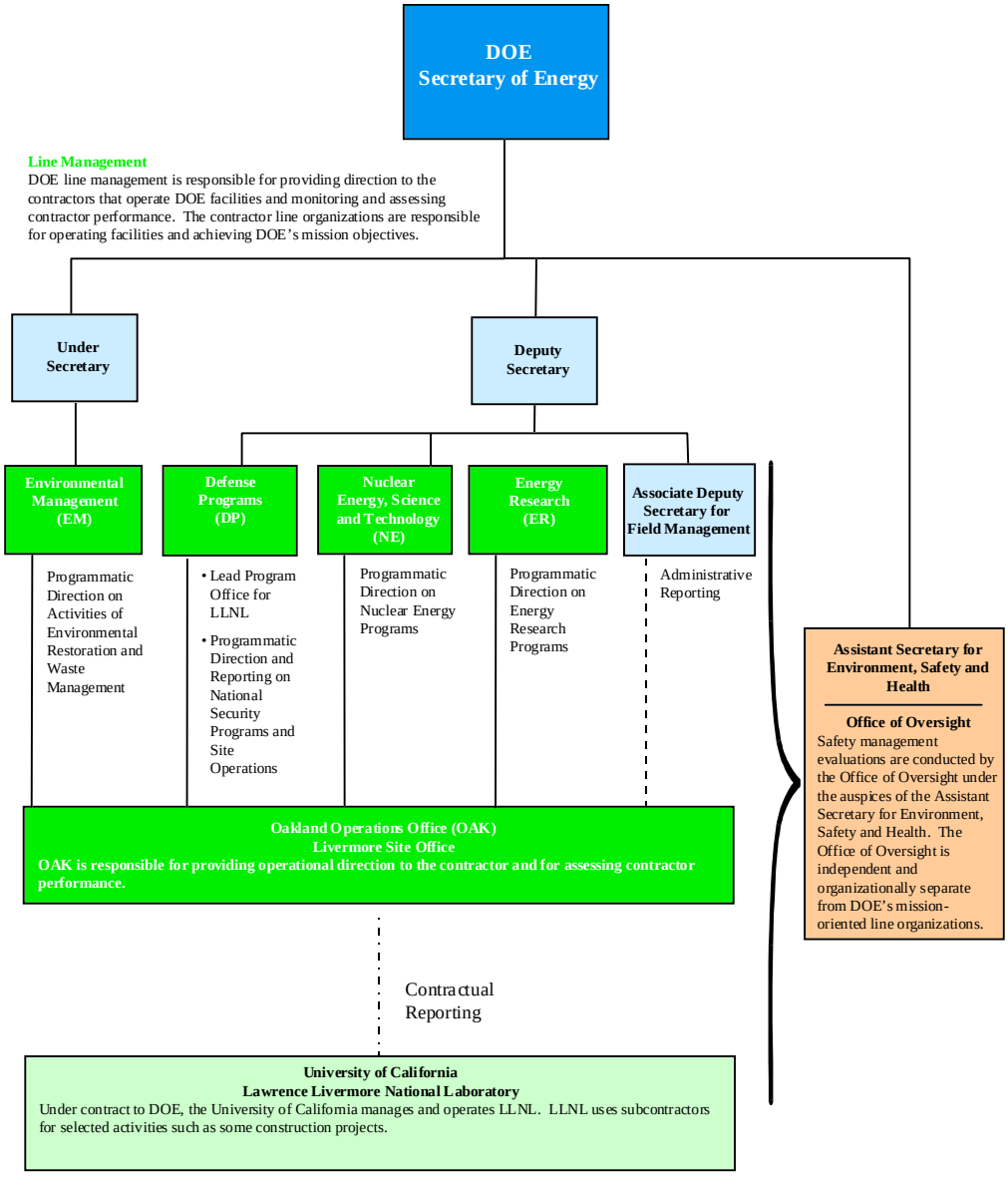

Figure 1. Organizations with Responsibilities at Lawrence Livermore National Laboratory

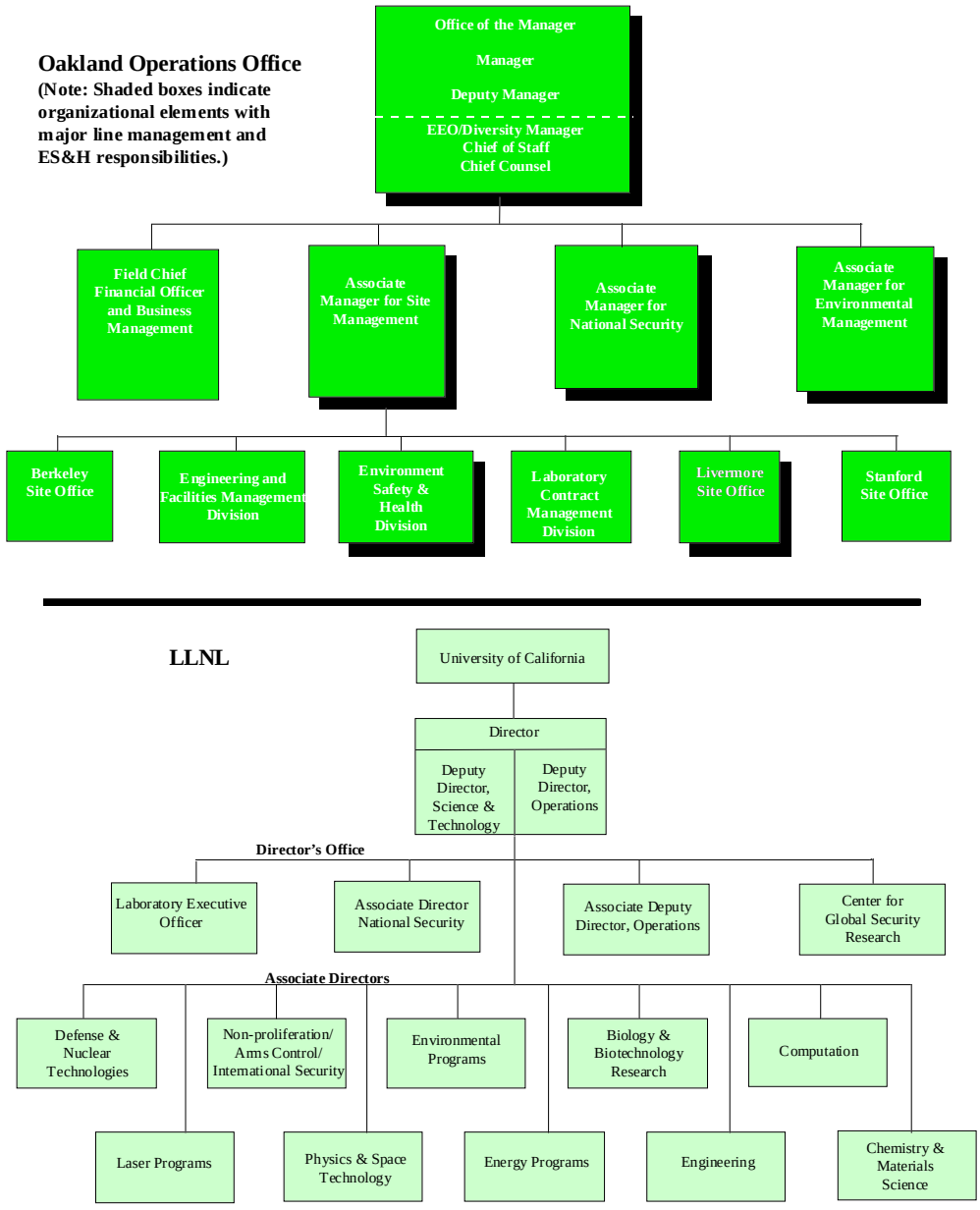

Figure 2. Oakland Operations Office and LLNL Organizations

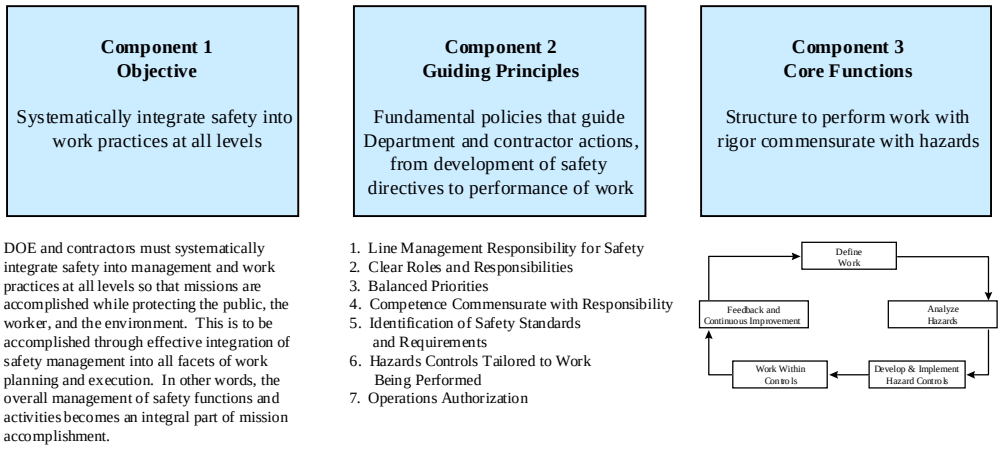

Figure 3. Components of DOE's Integrated Safety Management System

OVERVIEW OF LAWRENCE LIVERMORE NATIONAL LABORATORY (LLNL)

LLNL MISSION STATEMENT: "The mission of LLNL is to apply science and technology in the national interest. LLNL's focus is on global security, global ecology, and bioscience. Laboratory employees are working with industrial and academic partners to increase national economic competitiveness and improve science education. The Laboratory's mission is dynamic and has been changed over the years to meet new national needs."

ACTIVITIES: LLNL designs nuclear weapons and performs a variety of activities in support of the nuclear weapons stockpile stewardship. LLNL also performs research and development projects in a wide variety of areas, such as global ecology, non-proliferation and arms control, and bioscience. In addition, LLNL has a number of ongoing environmental restoration projects and a program to manage radioactive and mixed wastes. The U.S. government is currently in the process of turning over the Uranium Atomic Vapor Laser Isotope Separation facility to the United States Enrichment Corporation as part of a national effort to privatize uranium enrichment. LLNL will continue to provide research and development support to the United States Enrichment Corporation. LLNL is also working on the construction of the National Ignition Facility, which is a billion-dollar laser facility that will be used for experiments related to science-based stockpile management.

LOCATION: The LLNL site is located in Livermore, California, about 40 miles east of San Francisco. LLNL's Site 300 is about 15 miles east of the LLNL site. The LLNL site encompasses about 820 acres, and Site 300 occupies about 7,000 acres. The LLNL site is located adjacent to residential communities and growing commercial areas.

STAFFING AND BUDGET: LLNL employs about 6,600 full-time equivalent personnel. About 5,400 of the 6,600 full-time equivalent personnel are funded by the U. S. Department of Energy (the remaining full-time equivalent personnel are funded by other agencies or Cooperative Research and Development Agreements with universities and/or industry). The various subcontractors employ an estimated 800 full-time equivalents. The 1997 fiscal year budget for LLNL was about $1.03 billion, and the 1998 fiscal year budget is about $1.06 billion.

MAJOR FACILITIES: Major LLNL facilities include the Superblock, a limited-access area that includes Building 331, a former tritium facility that is in a transition state until a new mission is identified; Building 332, a facility used for plutonium and uranium research, testing, and fabrication in support of LLNL's nuclear weapons stockpile management program; Site 300 Environmental Testing, Chemical Processing, Mechanical Processing, and Firing facilities, which are used for processing and testing high explosives and other energetic materials and components; Waste Management Facilities (514 Area, 612 Complex, and Building 693), which are used for processing, storing, and packaging radioactive, hazardous, and mixed wastes; Chemistry and Materials Science Facilities (Buildings 222, 151, 235, and 241), which are used for a wide range of research and development projects; the 321 Complex, which supports site machining; the Uranium Atomic Vapor Laser Isotope Separation Facility, which performs research, development, and processes related to laser isotope separation; the Chemistry Facility (Building 132N), which is a new chemistry facility; and numerous buildings, experimental facilities, and areas used for research, development, and testing in many scientific disciplines, such as laser science, bioscience, materials science, non-proliferation, environmental science, and various other fields.

HAZARDS: The most significant potential sources of radioactivity include plutonium and uranium operations, laser operations, nuclear materials in storage, and radioactive and mixed wastes. Chemical and biological hazards include a wide variety of toxic materials used in experiments and research, oils contaminated with polychlorinated biphenyls, acids, caustic materials, and various chemicals and solvents used in laboratories and maintenance of facilities and equipment. Construction and decommissioning activities, and work in areas with chemical processes, high voltage, heavy equipment, high-energy steam, rotating machinery, magnetic sources, and cryogenic processes also present potential hazards.